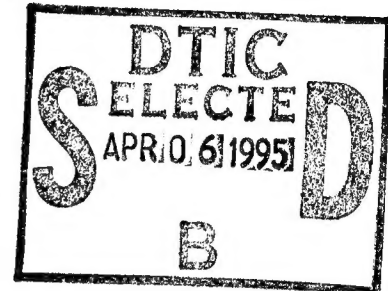


# AOARD REPORT

Visit to the Laboratory for Evaluation and Failure Prevention  
of Materials, Toyohashi University of Technology, 17 Oct 94

17 Oct 1994  
P. McQuay  
AOARD



This report summarizes a visit to the Laboratory for Evaluation and Failure Prevention of Materials, Toyohashi University of Technology, on 17 Oct 94. Discussions were held regarding a research proposal from Professor Niinomi to compare the microstructure/property effects of several emerging low cost Ti alloys from Japan and the US. Prof Niinomi's laboratory is well equipped to conduct static and dynamic fracture studies on a wide range of engineering materials, from very tough and strong steel and Ti alloys, to very brittle glasses and ceramics.

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AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

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TOKYO, JAPAN  
UNIT 45002  
APO AP 96337-0007  
DSN: (315)229-3212  
Comm: 81-3-5410-4409

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## 2. OVERVIEW AND BACKGROUND

Toyohashi University of Technology (TUT) is a small and relatively new technical university located in Toyohashi City, near Nagoya. The university was established in 1976, and began accepting students in 1978.

TUT is a unique national university in Japan because it was established primarily to provide an opportunity for higher education (BS and MS degrees) for students who have graduated from two-year technical colleges, who do not take the normal college entrance exams. TUT's unique program allows for these students to complete a BS degree in two years, by starting them at the 3rd year level, and to achieve a MS degree with two more additional years. Approximately two-thirds of the student body fall within this category, and most stay on to finish a MS degree. Students are also accepted to a normal 4 year program upon successful completion of the college entrance examination. Currently, TUT has enrolled approximately 950 undergraduate students, 680 MS students, and 54 doctoral students. The professional staff consists of approximately 74 Professors, and 75 Associate Professors, 3 Lecturers, and 69 Research Associates.

TUT has the following departments: Mechanical Engineering, Production Systems Engineering, Electrical and Electronic Engineering, Information and Computer Sciences, Materials Science, Architecture and Civil Engineering, Knowledge-based Information Engineering, and Ecological Engineering. Interestingly, the fields of study of chemical and physical metallurgy, and the design and evaluation of engineering materials resides in the Production Systems Engineering department, not in the Materials Science department, which is dominated by chemistry disciplines.

## 3. DISCUSSIONS

My visit to TIT was hosted by:

Dr. Mitsuo Niinomi  
Associate Professor  
Laboratory for Evaluation and Failure Prevention of Materials  
School of Production Systems Engineering  
Toyohashi University of Technology  
1-1 Hibarigaoka, Tempaku-Cho  
Toyohashi 441, Japan  
Tel: +81-532-47-0111 ext 819  
Fax: +81-532-47-2688

The primary purposes of the visit were to discuss a research proposal from Prof Niinomi, and to discuss his research on static and dynamic fracture toughness of structural materials. Research in his laboratory is conducted on a variety of structural material systems, including metal alloys and composites, ceramics and ceramic composites, polymeric composites, etc.

Prof Niinomi's laboratory is well equipped with a range of instrumented charpy impact-type test frames of various sizes, in addition to standard tensile test frames. His laboratory is also equipped with several unique test machines for conducting research on dynamic fracture, including a high-speed servo-hydraulic unit that can be used in several configurations such as 3-point bend, tensile, etc, and a one-of-a-kind impact fatigue machine which is used to obtain S-N curves in the relatively high cycle range. Additionally, TUT researchers have access to a reasonable selection of optical and electron microscopes, microprobes, and other analytical and characterization equipment.

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Prof Niinomi, in conjunction with the Iron and Steel Institute of Japan, has submitted a proposal to evaluate and compare the microstructure/property effects of emerging low cost and high performance titanium alloys from the US and Japan, which are possible candidates to be replace the Ti workhouse alloy, Ti-6-4. The proposal is entitled "Fracture Toughness and Processing Routes Relations in Commercial Titanium Alloys for Developing the Alternative Alloy for Ti-6-4." It is also hoped that new Ti alloys, some of which are believed to be much lower in cost due to greater ease of processing and fabrication, will be successful in markets where Ti-6-4 has proven to be too expensive. Examples of these alloys include the Timet Low Cost Beta alloy, and NKK's SP700 alloy.

He is also just beginning microstructure/property effects of cast gamma TiAl alloys, with an intent to concentrate on the dynamic fracture toughness behavior, which is still poorly characterized and understood.

#### 4. SUMMARY AND COMMENTS

Prof Niinomi's laboratory is well equipped to conduct static and dynamic fracture studies on a range of engineering materials. His group has experience with a wide variety of materials from the very tough and strong steel and Ti alloys, to very brittle glasses and ceramics.

Professor Niinomi commented that due to the unique background of most of his students, they are good at experimentation and application, but rather weak on theory. Because of this, he stated that his graduates are quite successful at finding jobs, even in these tough economic times. He did comment, however, that many of these students, because they did not prepare for and take the very rigorous college entrance exams, do not have a very strong or broad foundation in science and humanities (including English), which limits them from qualifying for PhD programs and often limits their career potential.